arm

TF-M split build

continue

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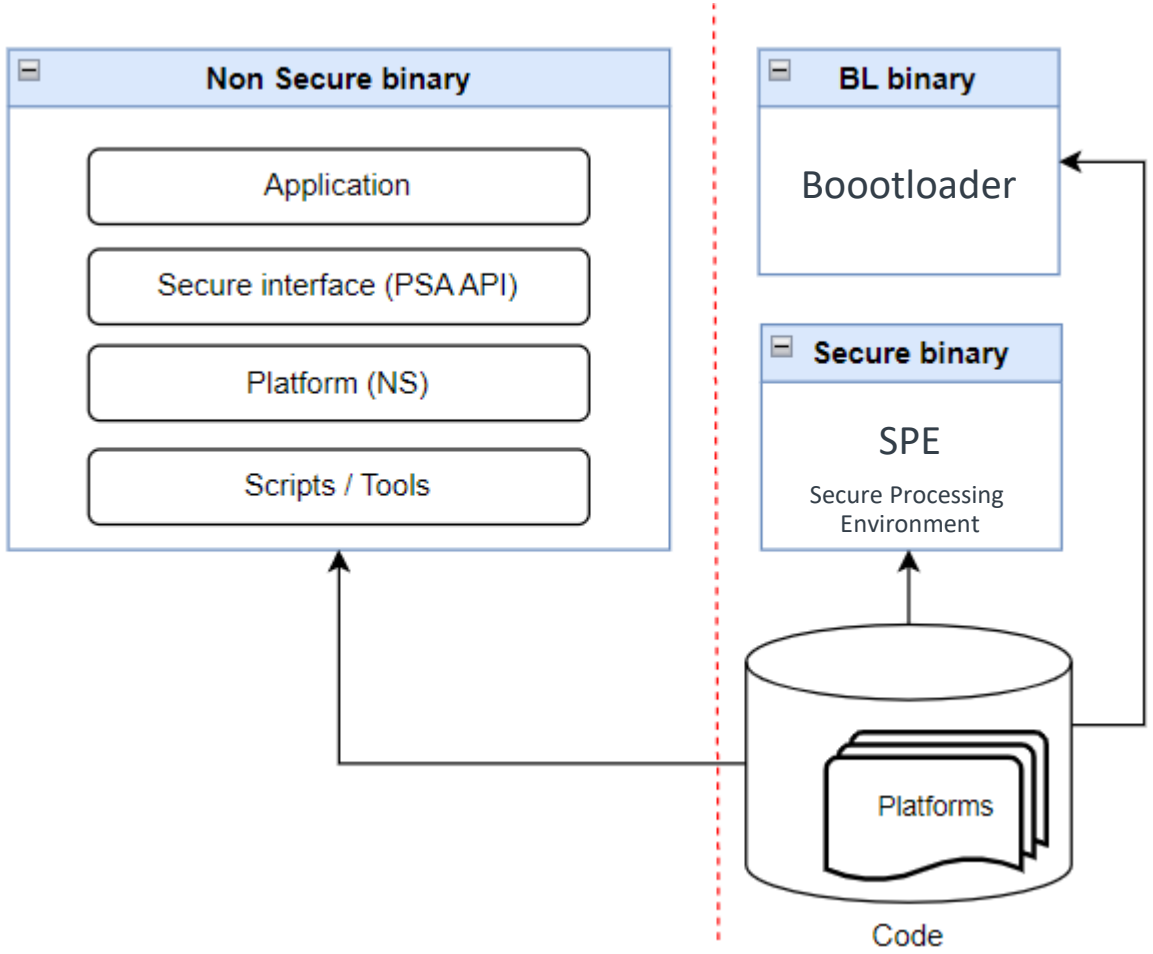
Background and problem definition

- A single build process for 3 binaries
- Sharing config options leads to:
  - Large and complex configuration set
  - High entrance barrier for TF-M App developer
  - Maintenance difficulty
  - Error-prone and vulnerable to side-effects
- Require tricks in CMake build script to support different CPUs on S and NS
- Build starts from SPE - reverse logic

- Can we reduce dependencies in this Client - Server scenario?
  - BL1, BL2 and S configurations are mainly defined by HW platform
  - Separate codebase for NS and S sides



Split build alternative

2 semi-independent projects

TF-M = SPE = Secure(S) side

- Developer selects
  - A platform
  - Secure service set
- A platform has highest config priority
  - CPU cores and HW capabilities
  - Memory layout and peripherals
- Outputs = exports = installs
  - PSA interface
  - BLs, S binaries
  - Bin image tools (signing, merging)
  - NS toolchains

- NS platform
  - Sources
  - MCPU + Arch

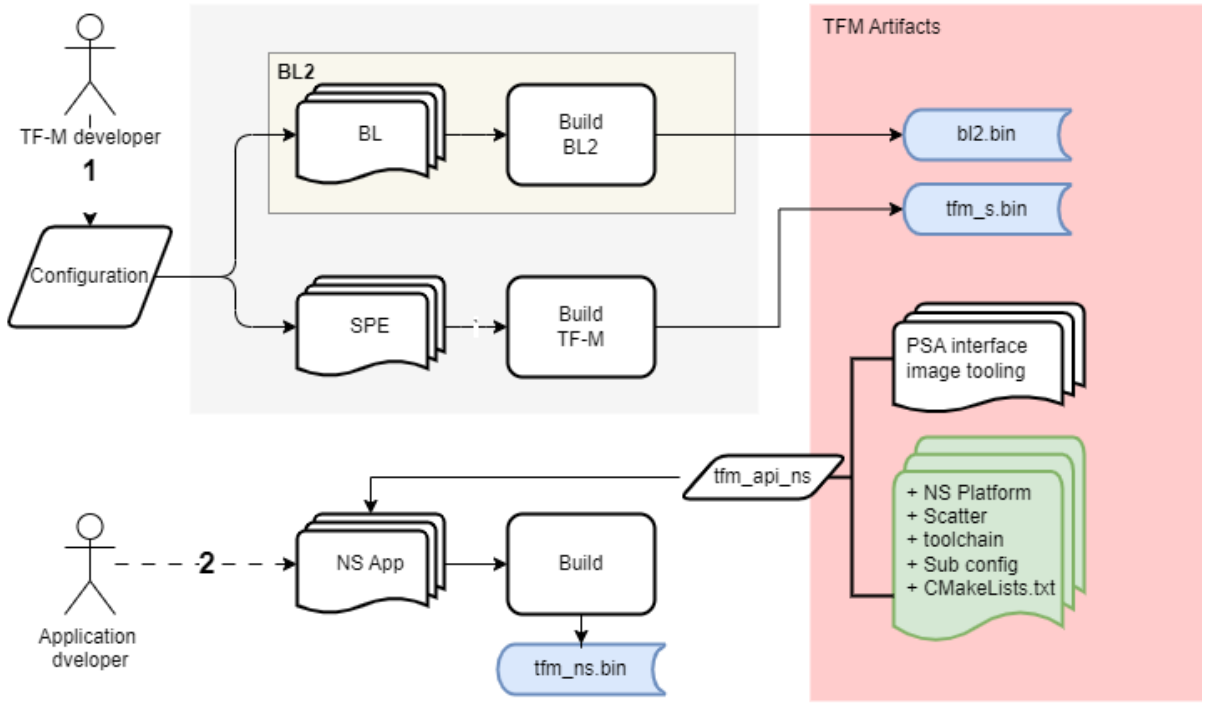
A platform specific

Application = Non-Secure(NS) side

- An application code
- Builds and links with NS platform sources
- Combines with BL, S binaries
- BLs and S
  - Stay the same
  - OEM can ship it in binaries
- Is independent from S build
  - Toolchain and options
  - S source tree

Implementation

- Installation script is extended to install:
  - Common NS platform files
    - CMSIS
    - Toolchaines
    - Link scripts/scatters
    - CMakeLists.txt for platform_ns
  - spe_config.cmake
  - spe_export.cmake
  - CMakeLists.txt for SPE
- A Platform installs
  - NS platform sources
    - Startup
    - Drivers
  - Linker script (scatter)
- TF-M does not dictate how to build TF-M application



Configuration

Most of configuration options are on S side

S side

- Configurations
  - Platform selection
  - Secure services
- Config mechanisms
  - Kconfig
  - Predefined or custom profiles
  - CLI settings
- A small subset of config options caried to NS application because:
  - A platform is selected
  - Partitions are defined

NS side

- Nothing to configure for TF-M itself
- App can retrieve some SPE options
- /api_ns
  - bin
  - cmake
  - interface
  - platform
  - CMakeLists.txt

```
include(spe_config)
include(spe_export)

add_library(tfm_api_ns)

add_subdirectory(platform)

target_link_libraries(tfm_api_ns
    platform_ns
    tfm_config
)
```

spe_config - variables
spe_export - definitions
platform/CMakeLists
CMakeLists

Platform porting steps

- Move S side **CPU** and **Arch** definitions from preload.cmake →config.cmake
- Add installation instructions for NS platform sources to CMakeListst.txt.
  - Following destination variables are available:
    - INSTALL_INTERFACE_INC_DIR - <dst>/interface/include
    - INSTALL_INTERFACE_SRC_DIR - <dst>/interface/src
    - INSTALL_INTERFACE_LIB_DIR - <dst>/interface/lib
    - INSTALL_IMAGE_SIGNING_DIR - <dst>/image_signing
    - INSTALL_CMAKE_DIR - <dst>/cmake
    - INSTALL_PLATFORM_NS_DIR - <dst>/platform
- All files from /**ns**/ folder will be installed. Those 2 are expected
  - ns/CMakeLists.txt - Script for building **platform_ns** target
  - ns/cpuarch.cmake - definitions of CPU and Arch
- Remove
  - preload.cmake
  - Traces of platform_ns, NS from <tf-m platform>/CMakeListst.txt
- Musca-B1 porting example: https://review.trustedfirmware.org/c/TF-M/trusted-firmware-m/+/23468/
- Takes about 1 day (with a luck)

“Hello TF-M” demo app

Ref: tf-m-extras/tf-m-example-ns-app [not merged at the demo time]

Main.c

```c
/*
 * Copyright (c) 2023, Arm Limited. All rights reserved.
 *
 * SPDX-License-Identifier: BSD-3-Clause
 */

#include "tfm_api.h"
#include "uart_stdout.h"
#include <stdio.h>

int main(void)
{
    uint32_t fw_version;

    stdio_init();

    printf("Non-Secure system starting...\r\n");
    printf("Hello TF-M\r\n");

    fw_version = psa_framework_version();
    printf("Firmware version = %d.%d\r\n", fw_version >> 8, fw_version & 0xFF);

    while(1);
}
```

CMakeLists.txt

```
#-------------------------------------------------------------------------------
# Copyright (c) 2023, Arm Limited. All rights reserved.
#
# SPDX-License-Identifier: BSD-3-Clause
#
#-------------------------------------------------------------------------------
cmake_minimum_required(VERSION 3.15)

set(CONFIG_SPE_PATH  /home/antkom01/hello-tfm/api_ns)

set(CROSS_COMPILE             arm-none-eabi)
set(CMAKE_TOOLCHAIN_FILE      ${CONFIG_SPE_PATH}/cmake/toolchain_ns_GNUARM.cmake)
list(APPEND CMAKE_MODULE_PATH ${CONFIG_SPE_PATH}/cmake)

project("TF-M Example"  LANGUAGES C)

add_executable(tfm_ns
    ${CONFIG_SPE_PATH}/interface/src/os_wrapper/tfm_ns_interface_bare_metal.c
    main.c
)

add_subdirectory(${CONFIG_SPE_PATH} tfm-api-ns)
target_link_libraries(tfm_ns tfm_api_ns)
```

Demo time

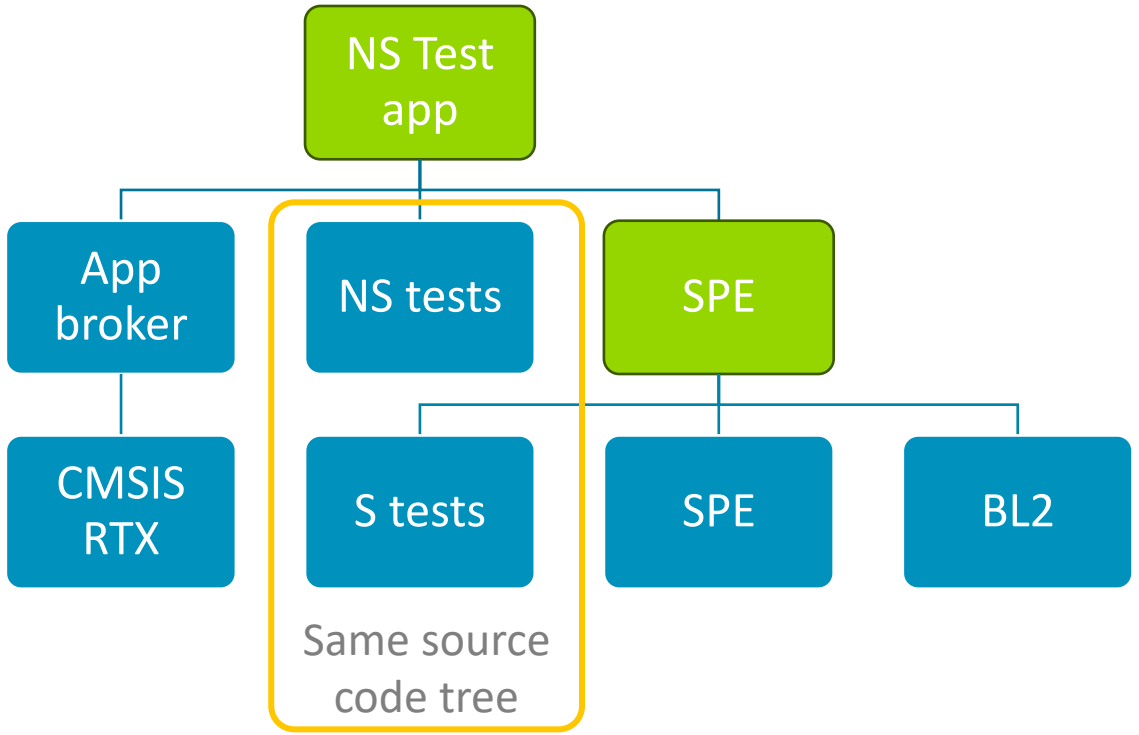
Tests

Are TF-M applications. Adopted and decoupled

Key changes

- Now builds as independent TF-M applications
  - Regression tests
  - PSA-Arch tests
  - ERPC server
- CONFIG_TFM_TEST_DIR
  - Included as sub_directory() into SPE build
- NS Tests execution environment is gathered into app_broker target
- Tests provides only entrance function:
  - void test_app(void *argument)

New structure



Current status

- Ported to an521, Musca-B1, Musca-S1 platforms
- Major regression tests and PSA Arch tests are passed on those platforms
  - Some tests (like FP) are not yet adapted
- OpenCI is ready for basic testing on the staging environment
- Changes are in **feature-build-split-v2** branches of **TF-M** and **tf-m-test** repositories
  - https://review.trustedfirmware.org/c/TF-M/trusted-firmware-m/+/23572
  - https://review.trustedfirmware.org/c/TF-M/tf-m-tests/+/23209/
- Open technical questions
  - Repositories version's synchronization: TF-M ⇔ tf-m-tests ⇔ tf-m-extras
    - Released versions are synched by tags
    - Use manual synchronization in a daily work
  - Mechanism for platforms to influence on NS exports
    - extend/redefine/overwrite common NS settings. No need so far but shall be useful in theory
- TODO:
  - Port to remaining platforms
  - Add ArmClang and IAR toolchains support
  - Documentation
  - Port ERPC testing framework
  - Clean Code tree from the single build remains
    - Deprecate obsolete config option

Discussion

- Deployment method
  1. One time switch in Nov 2023 release → TF-M v2.0.0
  2. Offer a deprecation time, but:
     - Overhead in maintaining 2 versions
     - Potential conflicts between them
     - Which version to test in CI

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Thank You
Danke
Gracias
Grazie
谢谢
ありがとう
Asante
Merci
감사합니다
धन्यवाद
Kiitos
شكرًا
ধন্যবাদ
תודה